ITCS 314: Automata and Formal Languages

Exam 1, Second semester 2014/2015, Form: A

Name: _____

Student Number: _____

Section: _____

25.5/35

Section 1. (1 point each)

Mark the following statements with **True** if they are true and **False** otherwise.

T The pumping lemma can be used to prove that the following language is non-regular $L = \{a^p : p \text{ is a prime number}\}$.

T The language $L = \{w \in \{a,b\}^+ : |w| \mod 971 = 0\}$ can be generated using a regular expression.

F Nondeterminisim is useless since every NFA can be represented by an equivalent DFA.

T The language $L = \{w \in \{a,b\}^* : w \text{ has at least 3 } a\text{'s and every } a \text{ is followed by at most two } b\text{'s}\}$ is regular.

T Given two regular languages L_1 and L_2, the language $L_1 - (L_2 \cup L_1)^*$ is also regular.

F The grammar $S \to aS|aaS|aaaS|A; A \to \lambda|bbA$ is a regular grammar.

T Every regular language can be generated by a right-linear grammar.

F The language $L = \{a^n b^m c^{n+m} : n, m \geq 0\}$ is regular.

T The following grammar $S \to aS|Sbbb|b$ represents the language $L = \{a^n b^{3n+1} : n \geq 0\}$.

T The regular expression $(00)^*(11)^*1$ generates the language that contains all strings with an even number of 0's and an odd number of 1's.

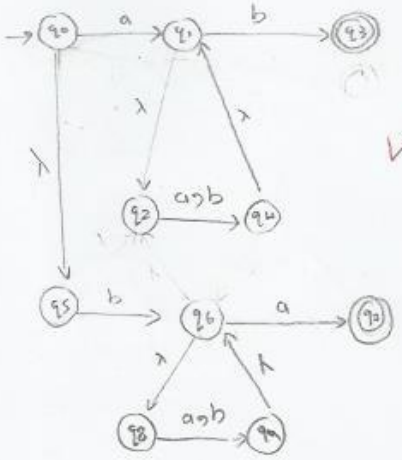
Section 2. (5 points each)

1. Consider the following language

$$L = \{w \in \{a,b\}^* : w \text{ starts and ends with different letters}\}.$$

Show that L is a regular language.

NFA



2. Assume that the symbols in a word w are numbered as $w = x_1x_2x_3\ldots$ (i.e. x_1 is at position 1, etc.). Find a regular expression for the language

$$L = \{w \in \{0,1\}^* : \text{every odd position in the word is 1}\}.$$

1 0 1 0 1 0 1 0 ...

1.5

$r = (10)^*$

X

3. If the following language is regular show that it is regular, otherwise prove that it is not regular.

$$L = \{www : w \in \{a,b\}^*\}.$$

5

Let $w = a^m b^m a^m b^m a^m b^m$

$= x \quad y \quad z$

Since $|xy| \leq m$, $|y| \geq 1$

$y = a^k$

$w_i = a^{m+(i-1)k} b^m a^m b^m a^m b^m$

$w_0 = a^{m-k} b^m a^m b^m a^m b^m \notin L$

∴ the language is not regular

4. Construct a regular grammar for the following language:

$$L = \{a^n b^m : n + m \text{ is odd}\}.$$

odd = Even + odd

$= n_a(w) + n_b(w)$

OR $= n_b(w) + n_a(w)$

2

$S \to aaS \mid a \mid b \mid A$

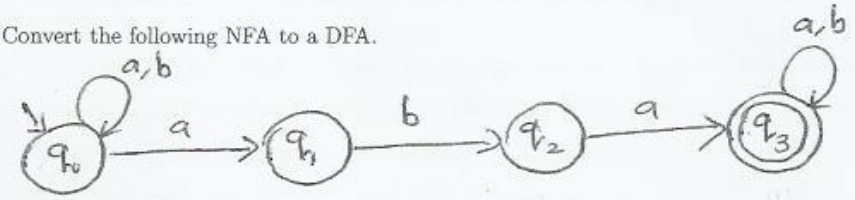
$A \to aB$

$B \to bbB \mid ?$

$(aa)^*a \cdot (bb)^*$

$(aa)^* \cdot (bb)^* b$

5. Convert the following NFA to a DFA.



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